story, but there is some indication of the real facts, especially for the last three months of the year when we began making regular daily tests, Sunday excepted. This is done for the sake of the school and the homes furnishing students, or offering board or lodging for them. It has been done freely, with the hope of serving the community as well as the school.

In the light of the fact that we are to have treated water soon, it will be more important to have data for comparison later. One thing that does not show is, that after fires in the city the water was much more likely to have *B. coli* present in it, or at least showing in the hydrant. Again, this has been an exceptionally wet year. The Neosho river—the source of our supply had floods or high water in it an unusually large proportion of the time. This accounts for the amount of gas showing in it. We have had but little typhoid fever. In my opinion it has been because of the freedom from this disease on the watershed, rather than because of the treatment which the water receives.

KANSAS STATE NORMAL SCHOOL, EMPORIA.

BOTANICAL NOTES.

FRANK U. G. AGRELIUS.

1. SOME PECULIAR LICHENS COLLECTED AT OSWEGO, KAN., SEPTEMBER, 1915.

WHILE collecting plants near Oswego, Kan., on the 4th of September, 1915, we collected what seemed to us to be hybrid lichens. At least there seemed to be two distinct species, with intermediate forms grading into each other.

The one I judge to be *Cladonia Pyxidata* (L.) Fr., the brown-fruited lichen; and the other *Cladonia rangiferina* (L.) Hoffm., one of the "reindeer lichens."

The intermediate forms pass from the former to the latter by a gradual disappearance of the scales and lobes characteristic of *C. pyxidata,* and a gradual assumption of the upright, much-branched habit of the reindeer lichens.

Lichens are symbionts, consisting of various fungi associated with various algæ, and as these were growing more or less intimately, it is reasonable to suppose that the various elements of the two symbionts might be somewhat forced into an

unnatural combination of the four possible elements. There would thus result a somewhat intermediate form. This seems to be the case, as one may judge by ordinary observation of the specimens submitted.

2. EXPERIMENTS IN OSMOSIS OF LIQUIDS. (FIG. 4.)

We had often tried this experiment and had never had the tube long enough. Assisted by Mr. Clifford Hall, a student in the department, we tried to see how far the liquid would rise under the conditions of the experiment.

For a membrane we used the skin of an ordinary egg. The

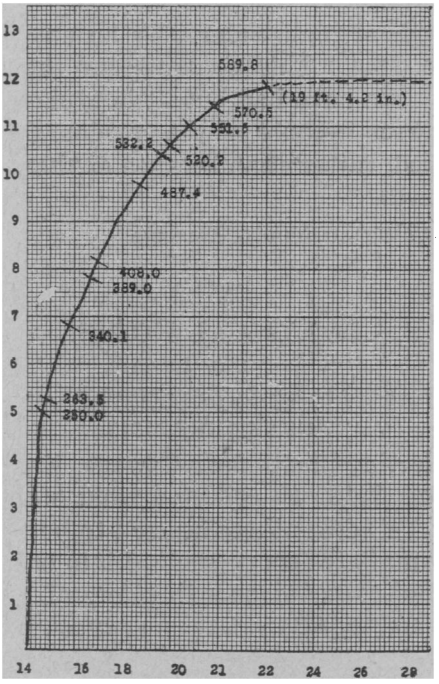

FIGURE 4. Osmosis test. 1 unit vertically = 5 cm. 1 cm. horizontally = 1 day.

shell was removed by immersion of the egg in 25 percent hydrochloric acid overnight. Care was taken to keep the egg covered by the acid by holding it under with a test-tube held in a clamp. The end of the egg thus treated was cut off with a razor, the contents removed, and the membrane washed in water. To contain the sorghum, a thistle tube with a short tube was used. The sorghum was full strength, and was the

material used to bring about osmosis. The cup of the thistle tube was filled with the syrup, the membrane slipped over it, and this supported by a piece of ordinary white cotton cloth. The cloth and the egg skin were then firmly tied with string. Connection was made to the rest of the tubing by means of rubber tubing. In order to have the proper height the experiment was set up in the hallway of the Science Building. The water used amounted to 1550 cc. As this became sufficiently colored to indicate the presence of syrup to a noticable degree, it was replaced by distilled water. The thistle tube with the membrane on it was immersed in the water 7.5 cm. This was on July 14, 1915.

The results in tabular form follow:

Date.	Hour.	Height of water in cm.
July 14, 1915.....	(?)	0.0
July 15, 1915.....	8:30 a. m.	250.0
July 15, 1915.....	10:00 a. m.	263.5
July 16, 1915.....	12:00 m.	340.1
July 17, 1915.....	9:00 a. m.	389.0
July 17, 1915.....	4:40 p. m.	408.0
July 19, 1915.....	10:00 a. m.	487.4
July 20, 1915.....	7:10 a. m.	520.2
July 20, 1915.....	6:00 p. m.	532.2
July 21, 1915.....	12:00 m.	551.6
July 22, 1915.....	12:05 p. m.	570.5
July 23, 1915.....	2:00 p. m.	582.7
July (?) 1915.....	(?)	589.8 (19 ft., 4.2 in.)

Our conclusion is that under these conditions the water will likely rise about 20 feet in the tube. It certainly is a striking experiment to show to pupils. This attracted much attention and helped to acquaint people with this fundamental principle in the economy of living things. We shall probably try it under different conditions.

3. THE RESTRICTED RANGE NOTED FOR *PARONYCHIA SESSILIFLORA* NUTT., IN KANSAS.

While doing some work for the State Biological Survey of the University of Kansas the writer noted what seemed to him a remarkable case of restricted environment. Work was begun that year (1911) on the 5th of July, in Logan county, at Oakley, on the Union Pacific. After working several weeks alone, we were joined by Mr. Orville Wilson, now of the botany department of the University of Cincinnati. The

work of the collection and study of plants and their environment was quite thorough in that county (Logan), and included some of Gove, Scott and Thomas counties. We then transferred to Sherman county, at a point about ten miles south of Goodland on the north fork of the Smoky Hill. Here we found fine conditions for a good and varied collection of plants. The topography is varied, as also the water conditions. We collected some fine hydrophytes, notwithstanding the severe drought of that summer. There are some rather pronounced breaks or buttes along the Smoky, and these gave us xerophytic conditions on their summits and points, and springs at their bases, with every gradation between.

On one of our excursions from camp we had separated for a short time, Mr. Wilson going to the head of a canyonlike depression, while I went down through it and towards the point of a bluff on the opposite side. This would give us all the conditions in that place and would be accomplished more satisfactorily. Reaching the opposite ridge ahead of Mr. Wilson, I decided to investigate the point of rock forming its limit and overlooking the valley. The arrangement is much like that of the pommel of a saddle, making the spot quite isolated. I here discovered a plant new to us. It formed a thick mat on the rocks, covering an area of perhaps twelve by fifteen feet. It was xerophytic in habit, as indeed it needed to be to survive such rigorous conditions. It would be exposed to the extremes of cold and heat in winter and summer, and to similar changes in moisture. It was prepared for this by a severely restricted amount of exposed surface. The leaves are needlelike and forbidding. The roots are well covered by the tufted upper parts and are woody. The soil that may be formed is held by the matted habit. The roots took advantage of the nooks and crannies in the rock to seek for moisture and further protect themselves. The whole plant was but a few inches high. It had well occupied the spot, however, and there were many individuals, all told. This proves that it found the conditions favorable for its growth.

We made the usual notes and collected specimens of the plant. Upon study we found it to be *Paronychia sessiliflora* Nutt., a member of the Illecebraceæ or knotwort family. Britton and Brown give its habitat as follows: "In dry soil, Saskatchewan to Montana, Nebraska, and Colorado."

The finding of a new plant was for us always an event of importance, and we always kept such in mind and always looked the more assiduously for it again. This one seemed especially peculiar to us, and so we kept it particularly in mind. We completed our survey there, visited the western and the northern parts of that county, and next moved to Cheyenne county. Here and in Rawlins county we found many places that we considered similar to the one described, and we searched carefully for our new friend, whitlow-wort, but completely in vain. That spot of earth or rock, twelve by fifteen feet in extent, seemed to be its limits within the region covered by the survey. A thorough study of Scott and Wichita counties, and a slight one of Greeley, failed to reveal a trace of this plant. We presume it to be doubtful whether it exists naturally in any other part of our state.

We judge that it has probably been carried to this spot by birds, this being a natural alighting place. However, Indians, or wild animals other than birds, using it also as a point of vantage, resting where they could see widely, and hence be safe from surprises by enemies, might possibly have inadvertently dropped the seeds here.

However this may be, the plant is there, and in what seems to us a very circumscribed area, considering the possibilities of the case.

4. NOTES ON THE UNUSUAL SEASONABLE ACTIVITIES OF CERTAIN PLANTS, 1915.

While on a trip to Oswego, Kan., we were surprised to note one of the wild onions in full bloom, and this on the 4th of September. This set us to observing, and as a result we have the following list to report. Unless otherwise stated, the plants were found in or near Emporia, Kan., and were in bloom at the date given. The month or season mentioned is the one in which flowering usually takes place. By comparison with the date first given in each case, one may see how far the plants are out of ordinary in this respect.

Sept. 4. Wild onion. *Allium mutabile* Michx. Oswego. April, June.
Sept. 5. Wild onion. *Allium mutabile* Michx. Near Clements, Kan.
Nov. 6. Cultivated Yellow Rose. *Rosa sulphurea* Ait. (?) Spring, Summer.

Nov. 7. Cultivated strawberry, in fruit and for sale. Evidently the ordinary kind, not the everbearing. *Fragaria chiloensis* Duchesne, var. *ananassa* (?). In Missouri as noted in the Kansas City *Star*.

Nov. 8. Ordinary cultivated strawberry. Flowers and immature, green fruit. Writer's garden, 1501 Rural street. May, June.

Sweet Pea. *Lathyrus odoratus* L. Summer.

Pear, *Pyrus communis* L. Spring.

Apple, *Pyrus malus* L. Spring.

Spiræa callosa-alba. (*Spiræa japonica* var. *callosa-alba* (?).) Spring and Summer.

Spiræa van Houttei (?). Spring.

Shepherd's purse. (*Capsella bursa-pastoris* (L.) Medic.) Early spring.

Bird's foot violet. *Viola pedata* L. (In our garden.) April, May, and late summer and autumn.

Canna sp. Late summer and fall.

Cultivated larkspur, from this year's seed. *Delphinium consolida* L. (?). Summer and fall.

Red sage. *Salvia splendens* Sellow. Summer and fall.

Cosmos bipinnata Cav., from this year's seed. Summer and fall.

Dandelion. *Taraxacum officinale* Weber. April-September, and rarely autumn and winter. From this year's seed.

Sweet alyssum. *Alyssum maratimum* Lam. Summer.

Sow thistle. *Sonchus asper* (L.) Hill. Summer and autumn.

Nasturtium. *Tropæolum majus* L. Summer.

Radish. *Raphanus sativus* L. Late spring and early summer.

Tomato. *Lycopersicum esculentum* Mill. From this year's seed. Summer.

Cardinal raspberry. *Rubus* sp. June to August. Has green fruit.

Yellow sorrel. *Oxalis stricta* L. April-October.

Garden Pea. *Pisum sativum* L. Fruiting. Late spring and early summer.

Mignonette. *Reseda odorata* L. From this year's seed. Old ones are blooming again. Summer.

Pepper grass. *Lepidium virginicum* L. (?) May-November.

Erigeron canadensis L. In abundance. June, November.

Corn. *Zea mays* L. Self-sown; this year's seed. This was suckerlike. June-August.

Sultana. *Impatiens sultani* Hook. Reflowering after some cessation and killing of some by frost. Summer and fall.

Nov. 10. *Narcissus* sp. Early spring. (Reported by Myrtle C. Hunter.)

Nov. 11. Yellow sweet clover. *Mellilotus officinalis* (L.) Lam. Summer.

Erigeron ramosus (Walt.) B. S. P. May-November.

Mouse-ear chickenweed. *Cerastium brachypodum* (Engel.) Robinson. March-July.

Nov. 13. Wild strawberry. *Fragaria virginia* Duchesne. April-June. (Reported by Claire Agrelius.)
Wild violet. *Viola cucullata* Ait. April, May. (Reported by Kenneth Agrelius.)
Nov. 14. A heavy frost occurred on this date.
Nov. 16, and several days later. Bridal wreath. *Spiræa prunifolia* Sieb. and Zucc. June.
Nov. 19. Mustard. *Brassica nigra* (L.) Koch. (?). June to November. (Reported by Roy Morrison, a pupil.)
Nov. 24. Mayweed. *Anthemis cotula* L. June to November. (Collected by Morrison.)
Jan. 3, 1916. Dandelion in blossom. Many heads were scattering fruits. A few days previous to this the temperature was one degree below zero.

Several of these plants were in bloom at periods later than the date noted. One notable instance was the bird's foot violet. No exact date was recorded, and hence cannot be given.

Below the same plants are arranged in the order given in Gray's Manual, seventh edition. Common names are omitted.

Plant.	Date of observation.
Zea mays L.	Nov. 8, 1915
Allium mutabile Michx.	Sept. 4, 5, 1915
Canna sp.	Nov. 8, 1915
Narcissus sp.	Nov. 10, 1915
Cerastium brachypodum (Engel.) Robinson	Nov. 11, 1915
Delphinium consolida L.	Nov. 8, 1915
Alyssum maratimum Lam.	Nov. 8, 1915
Lepidium virginicum L. (?)	Nov. 8, 1915
Capsella bursa-pastoris (L.) Medic.	Nov. 8, 1915
Raphanus sativus L.	Nov. 8, 1915
Brassica nigra (L.) Koch. (?)	Nov. 19, 1915
Reseda odorata L.	Nov. 8, 1915
Spiræa japonica L., var. *callosa-alba* (?)	Nov. 8, 1915
Spiræa trilobata L., var. *van Houttei* (?)	Nov. 8, 1915
Spiræa prunifolia Sieb. & Zucc.	Nov. 16, 1915
Pyrus communis L.	Nov. 8, 1915
Pyrus malus L.	Nov. 8, 1915
Fragaria virginiana Duchesne	Nov. 13, 1915
Fragaria chiloensis Duchesne, var. *ananassa* (?) (Fruit mature and sold)	Nov. 7, 1915
Fragaria chiloensis, etc. Flowers and green fruit	Nov. 8, 1915
Rubus sp. Has green fruit	Nov. 8, 1915
Rosa sulphurea Ait. (?)	Nov. 8, 1915
Mellilotus officinalis (L.) Lam.	Nov. 11, 1915
Lathyrus odoratus L.	Nov. 8, 1915
Pisum sativum L. Fruiting	Nov. 8, 1915

Plant	Date of observation.
Oxalis stricta L.	Nov. 8, 1915
Tropæolum majus L.	Nov. 8, 1915
Impatiens sultani Hook	Nov. 8, 1915
Viola pedata L.	Nov. 8, 1915
Viola cucullata Ait.	Nov. 13, 1915
Salvia splendens Sellow	Nov. 8, 1915
Lycopersicum esculentum Mill	Nov. 8, 1915
Solanum nigrum L.	Nov. 8, 1915
Erigeron ramosus (Walt.) BSP.	Nov. 11, 1915
Erigeron canadensis L.	Nov. 8, 1915
Anthemis cotula L.	Nov. 24, 1915
Taraxacum officinale Weber	Jan. 3, 4, 1916
Sonchus asper (L.) Hill	Nov. 8, 1916

5. UNUSUAL GROWTHS OF TWIGS OF SEVERAL PLANTS IN THE SEASON OF 1916.

Along with the unusual flowering of certain plants we have noticed indication of abnormal twig development during the season just passed. We noticed this in the apple, apricot, peach and pear. The unusual appearance is in the fact that the twig which has all developed this season has the appearance of two or more intermediate zones of bud-scale markings. Thus the appearance of two or three years' growth results in the same season. Naturally, then, we cannot always depend upon external appearances in determining the age of a twig. It may be that more careful examination would solve the question, but a cursory one will not.

The presumption is that one or two regular, or seemingly regular, winter or resting buds were formed by the twig, and then growth was again resumed in the same growing season. This all occurred in these trees without any artificial influence so far as we know. There was no watering done except what nature did. Indeed, we lost several trees this year from drowning, we are inclined to believe, and hence we were not tempted to add any more water.

The proof that the part of the twig in question grew all this past season is in the fact that this same part had the clothing of leaves on it that only results from the elongation of a terminal bud. Then in this particular case we had pruned the trees this spring and the place of pruning is still plainly visible, or enough so to determine what part of the tree grew this year.

A question at once arises as to whether this unusual external appearance would also be accompanied by deceptive internal records in the so-called "rings of growth." It is a well-known fact that resumption of growth in the spring is accompanied by a zone of woody tissue, containing at least larger water-tubes and other elements of the xylem, showing more open construction, thinner walls, etc. We have examined cross sections of this material and can say rather positively that there is not as pronounced a difference between the various layers added during the season as that usually found in the regular rings of growth. In some parts of a section there are some fairly well marked rings, but in others there is little to distinguish one part from another. A section might well be termed characterless. This might be expected when one considers the long-continued wet weather and coolness. Still there was enough difference at times to bring about retardation or cessation of growth, and then its recurrence. We hope to be better able to judge as to the facts when we shall have been able to secure twigs of what may be a more nearly normal season.

One peculiarity of the results this season is that some twigs on a tree show the above-mentioned marks of cessation and renewal of growth, while others do not.

In connection with the subject we wish to add that, in our opinion, a growing season with the usual spring and summer attributes, followed by a wet fall with renewal of growth, is more likely to disturb the annual markings than is one like the past season.

We conclude this, however, that outward appearances may be definitely deceptive as to showing the age of a twig.

6. DATA CONCERNING THE DISSEMINATION OF WHEAT RUST (*PUCCINIA GRAMINIS* PERS.)

Puccinia graminis Pers. in its complete development has five kinds of spores, as follows: spermatia, æcidiospores, uredospores, teleutospores, basidiospores. This last kind is produced by the teleutospores in the spring. These infect the young leaves of the barberry. The work of the spermatia is not known. These and the æcidiospores are found on the barberry. The latter infect the wheat. The fungus in the wheat at first gives rise to uredospores, which infect more wheat and thus spread the rust. Later the same mycelium produces the

teleutospores, or the black rust. These carry the fungus through the winter.

It will be seen that there are two hosts. It follows that if one host, or if any one stage, excepting the spermatia, be disposed of, then the rust will be stopped. It happens that in Kansas there is a negligible quantity of barberry, and yet we have much rust. It is true that there are other wheat rusts besides *Puccinia graminis,* but we have much that is apparently this species. Some other explanation must be had.

It may help some in understanding the problem to state that presumably only the æcidiospores and the uredospores are capable of infecting the wheat. Æcidiospores are probably only on the barberry, and we do not have the barberry. Uredospores are not supposed to withstand the winter, but we still have the rust. What is the answer to these seemingly contradictory statements? We shall endeavor to sum up the various theories, and perhaps add some original suggestions or facts having some bearing on the subject. It is an important one, as a loss estimated at one hundred million dollars annually in the world is said to occur from this parasite.

Strasburger[1] thinks that the fungus persists through the winter in the winter wheats. This would have to be infected in the fall, presumably from volunteer wheat, and this in turn from uredospores still retaining their vitality from the harvested wheat. Coulter[2] is authority for the statement that uredospores have been known to have lived through the winter and infected the wheat in the spring. He also states that teleutospores have been known to produce basidiospores capable of infecting very young wheat plants. Whether these could infect winter wheat plants started the fall before is an open question. Possibly there might be some wheat lying ungerminated in the soil, and that this could furnish the needed young plants. The teleutospores do not germinate until in the spring, it will be remembered.

We have often suggested to our students that there is some probability that the fungus is conveyed to, or is at least found in, the related perennial grasses near the wheat; that it there persists through the winter and again produces uredospores capable of infecting the related wheat. This suggestion is

1. Strasburger, Textbook of Botany, p. 407.
2. Coulter. Textbook of Botany, vol. 1, p. 85.

original with us, but we cannot claim priority. The objection brought forward by some writers is that there are physiological races existing in this fungus that are each confined to a rather narrow choice of hosts. Duggar states that in the race on which wheat is included also includes *Hordeum, Agropyrum* and *Elymus*. All of these are represented in our flora, the second and third by perennials; for example, *Elymus canadensis* L, wild rye. The same author classes the oat in a different race from that of the wheat. Considering the fact that the fungus has leaped over its main characteristics sufficiently to omit one of its fundamental, well-established characters, we are loath to believe that the form on the oat is not capable of infecting the wheat. We have long ago learned, however, that opinions do not affect facts!

In our opinion, while other theories may account for the wintering of wheat rust here in our section, this fungus persists and succeeds without the æcidium stage, because of the presence of many native and mostly perennial grasses. Some of our reasons are that these grasses are to be found quite intimately associated with the cultivated grains. Secondly, that we have found them retaining their green color and still evidently infected with a fungus presumably alive within the tissues of the grass. We collected some of this on the third of this month (January), following zero weather. On the same day we collected *Dactylis glomerata* L., orchard grass, with uredospores on the green leaves. These did not appear to be true red rust of wheat, however, although they appear much like some found on wheat. We have collected and here present a specimen of what is probably *Panicum virgatum* L., with an abundance of red and black rust on it. Upon examining these with the microscope the spores are found to be typical *Puccinia graminis*. They may be of such a race that they cannot infect wheat, but their external characteristics do not bear out such a conclusion. *Panicum virgatum* L., is a perennial grass very common in Kansas. It is often found very close to grain fields.

Our contention must still be considered theoretical, however, as we have not demonstrated it. Nevertheless we have much faith in the correctness of it and we shall endeavor to search for facts having a bearing on it.

KANSAS STATE NORMAL SCHOOL, EMPORIA.